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of fluctuation, and the observer one for whom closing the eyes was a reinforcement. This condition was obtained but once in the entire set of experiments. Miss Killen concludes, then, that the Münsterberg phenomenon can be more easily explained from the central than from the peripheral theory.

Two facts that must have an important bearing upon any theory of attention waves result from the investigation of Dr. Dunlap.

1. Interruption of a minimal sound during the period of disappearance was in more than half the cases correctly noticed by the observer. The sounds were given by tuning-fork and telephone, and could be easily interrupted by the experimenter. The experiments were extended to show that sounds which were inaudible when continuous could be heard at their beginning or cessation. It is noteworthy that the cessation attracted attention more often than the beginning. The author does not attempt any theory, but lets the facts stand for what they are worth. To the reviewer, however, they seem to make strongly for a central theory. Certainly if the peripheral connections were entirely broken there could be no consciousness of the interruption. The fact also suggests an explanation of Pace's observation that when a weak visual stimulus was interrupted during the period of invisibility an after-image could still be seen.

2. In direct contradiction to both Dr. Heinrich and Professor Titchener it was found that minimal pure tones fluctuated. Both tuning-forks and the singing flame were used as sources of sound, and each of five observers clearly noticed the fluctuations.

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Die Farbenempfindung der Netzhautperipherie bei Dunkeladaptation und konstanter subjectiver Helligkeit. WILHELM PETERS. *Archiv für die Gesamte Psychologie,* III., 4, 1904, S. 354–387.

This investigation is concerned with a determination of the relative sensitivity of the different regions of the retina to brightness and to saturation. Peters worked in the dark-room of the psychological laboratory at Leipzig, with a modified form of the Hellpach perimeter. His four stimuli—red, yellow, green and blue—were, like Hellpach's, built up by means of light transmitted through appropriate color filters.

The most prominent feature of Peters's results is their extreme irregularity. The author feels justified, however, in interpreting them to mean that the retinal surface is to be regarded as a tripartite structure, containing a semiperipheral zone upon which color-stimuli appear in lesser saturation than upon more central and more peripheral regions. This interposed zone of minimal saturation is said (*S.* 380) to extend in the great majority of cases, from 35° to 55°, but his tables (*S.* 370f.; 374–8) indicate that its position and extension are wholly fortuitous. Thus it may extend from 15° to 45°, from 15° to 55°, from 15° to 25°, from 25° to 35°, from 25° to 75°, or from 45° to 65°. On one half-meridian it occurred twice, at 15° and again at 65°; while in numerous instances it did not have the breadth of extension claimed for it. Thus it occurred once, only at the point 55°; twice, only at 25°; seven times, only at 35°; five times, only at 45°; and in one third of his explorations it did not occur at all.

A similar irregularity characterizes Peters's determinations of brightness sensitivity. He attempts to express these results in a series of general laws (*S.* 369), but here again his statement of the case is at variance with his data. For instance, he assures us that with maximal luminosity of stimulus, red and yellow decrease, while green and blue increase in brightness, upon the paracentral regions. But of the two sets of curves upon which the former assertion is based, one (Fig. 9) shows a wholly different relation. Then too, we are told that after red and yellow have reached their minimum, there occurs a distinct increase of brightness upon more peripheral regions. But his curves contain no justification for such a statement. In short, it is impossible to find a general characterization for the results of this investigation excepting in terms of their irregularity and inconclusiveness.

What Peters has done is briefly this: He has explored the retina under varying conditions of fatigue. The initial stimulus of each series was applied to a rested region of the periphery. Subsequent stimulations were repeated without sufficient intervals of pause to allow the retina to recover from the effects of its previous stimulations. So that with the progressive advance of each series towards the fovea, fatigue phenomena occurred in increasing degree. In Peters's results the presence of fatigue is manifested not only by the diminution of saturation and of brightness, but by the appearance of the complementary color tone as well. Thus, he reports that upon regions where a moderate green stimulus normally excites the sensation of yellow, it appeared in various tones of blue; he found that red and yellow also appeared blue while blue appeared yellow. The results yielded by this method are necessarily irregular because the degree of fatigue induced was not constant throughout. Certain of these results—the complementary phenomena—he dismisses with the naïve remark that he is not interested in discovering whether they are due to contrast or to fatigue (*S.* 360); the remainder are made to do service as a measure of the relative sensitivity of the various regions of the *non-fatigued* retina. The net result of the whole investigation is a demonstration of the fact that with different degrees of retinal fatigue, fatigue phenomena occur in different degree.

A chief difference between the methods employed by Peters and by Hellpach consists in the different direction of progressive exploration in the two cases. Peters began his series at the periphery and worked in a centripetal direction, while Hellpach, in his final determinations, proceeded peripheralward from an intermediate region. It was inevitable, then, that the latter should find his zone of complementary colors at the periphery, and that the former should find his zone of complementariness and diminished sensitivity upon a more central region.

The paper under review is after all an improvement upon the previous investigations carried on in the same laboratory by Kirschmann and by

Hellpach, in that Peters recognizes the significance of luminosity of stimulus. It is to be hoped that he will repeat his determinations, employing a method which provides for uniformity of adaptation and for equality of color-value of stimuli. Moreover, it is to be mentioned that no investigation of this topic is complete which refuses to take into account the fact that certain colors do not change in tone in passing across the retina.

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A Factor in Mental Development. Margaret Floy Washburn. *Philosophical Review,* November, 1904.

"When we trace the development of mental life upward from the lowest forms of the animal kingdom, we are led to believe that the process has been marked chiefly by progress in two respects: first, advance in the power to discriminte among stimuli, and second, the rise, somewhere in the course of development, of the power to form 'free ideas' . . . It is the aim of the present paper to indicate how both these great gains of psychic evolution have been dependent in part at least upon one factor: the organism's growing power to react to stimuli not in immediate contact with the body."

In support of the first part of her thesis the author points to the fact that "stimuli such as light or sound, which can not directly and instantaneously affect the organism's life, are those which have given rise to the greatest number of qualitatively distinguishable sensations. The reason is that, since it is unnecessary for the organism to make . . . instant response to such stimuli, it is at liberty to spend its psychic energies on qualitative analysis. Time can be taken to find out what the stimuli are, because it is not so desperately necessary to discover where they are and act accordingly. . . . On the other hand, the two classes of sensations that illustrate clearly how qualitative discrimination may be swamped through the immediate need for local discrimination are touch sensations and, preëminently, sensations of pain. Here the stimulus . . . is where it may injure, or actually is injuring. Immediate motor response . . . is demanded; there is no time for qualitative investigation. To say that the contact senses have fewer qualities than sight and hearing because the variety of stimuli for sight and hearing is greater, is obviously to beg the question completely. There is as much variety in the chemical constitution of bodies as there is in the ether or air disturbances which they send to us."

In support of the second part of her thesis Professor Washburn urges that stimuli, which by reason of their immediate bearing upon the welfare of the organism are at once transformed into motor reactions, do not have time to make a very deep impress upon the brain. "But when the creature has developed a capacity to be affected by light and sound . . . then the current of energy sent by the stimulus into the nervous substance is not at once drained off, but may linger sufficiently long to produce whatever alteration, whatever impress upon sensory centers, is needful to insure their subsequent functioning as the basis